Insertion Sort

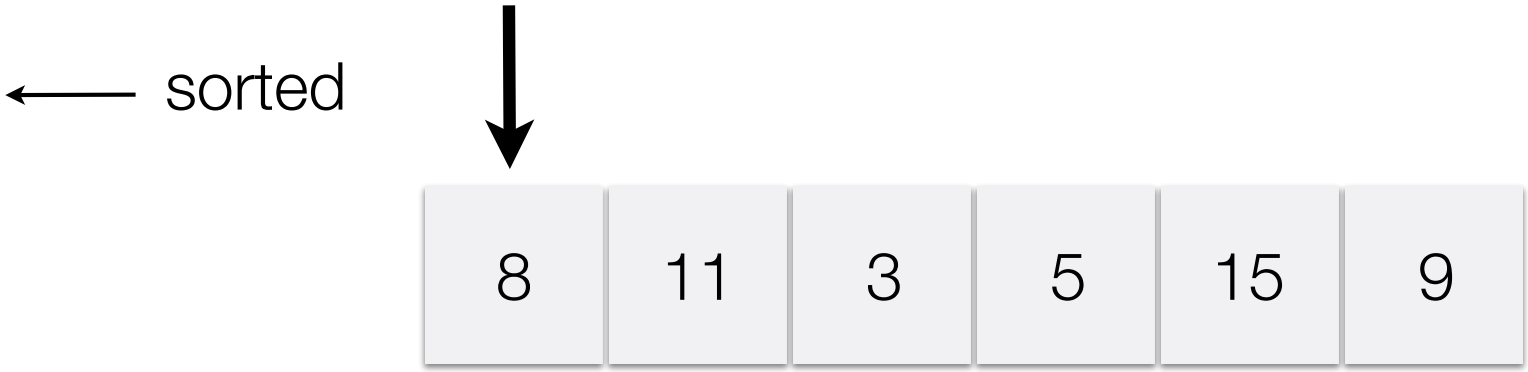
For all elements in the list from left to right:

    while current element less than left neighbour:

        swap elements

Insertion Sort

Insertion Sort



Insertion Sort

Current 8

Insertion Sort

Current 8

No elements
to the left

Insertion Sort

Current 8

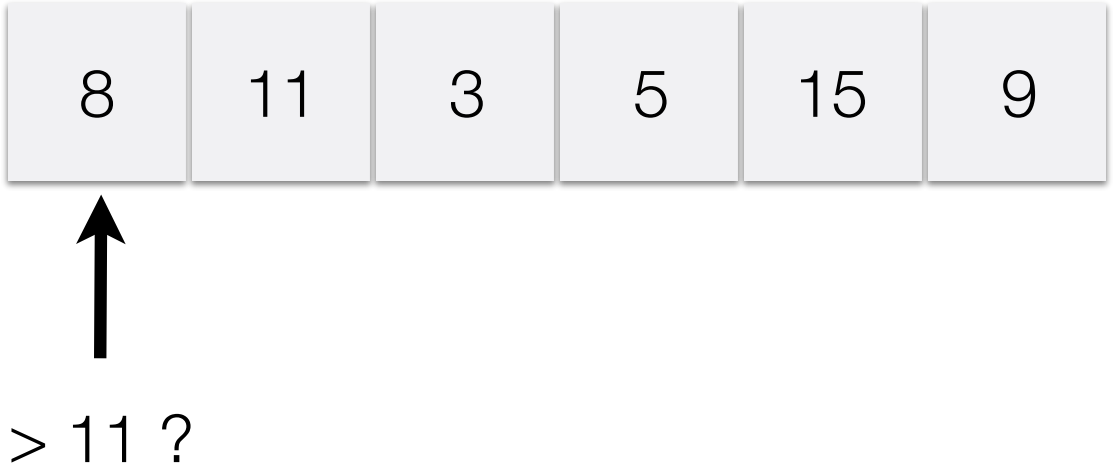
Insertion Sort

Insertion Sort

Current 11

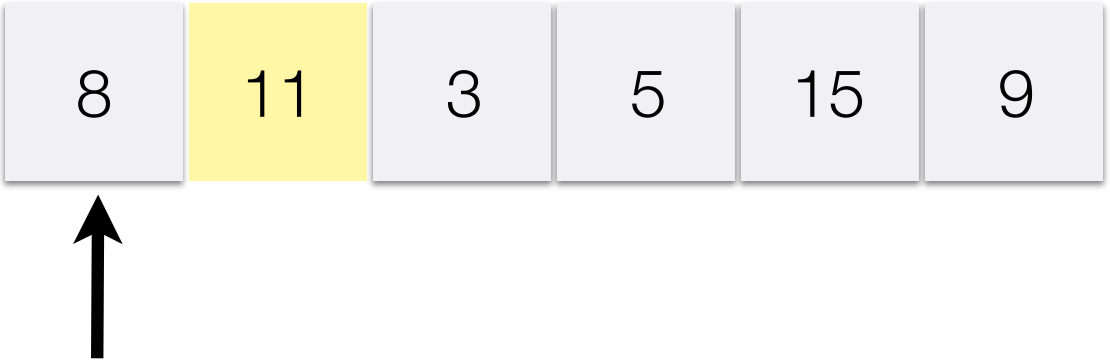
Insertion Sort

Current 11

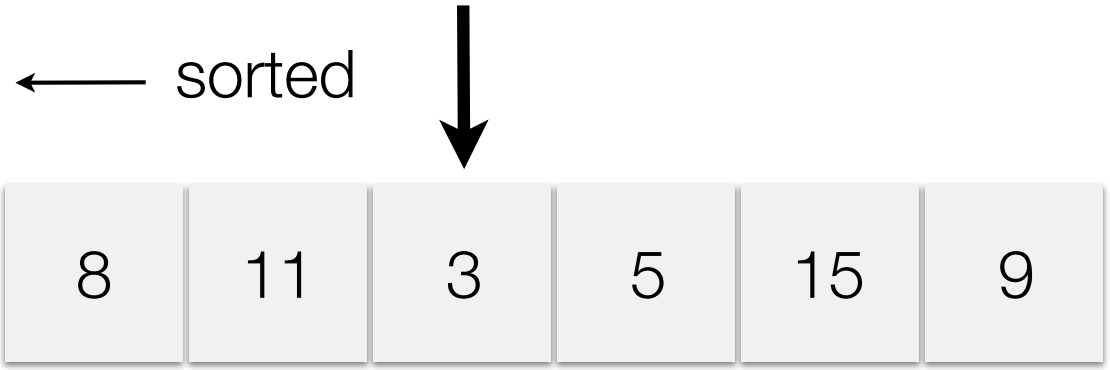


Insertion Sort

Current 11



Insertion Sort

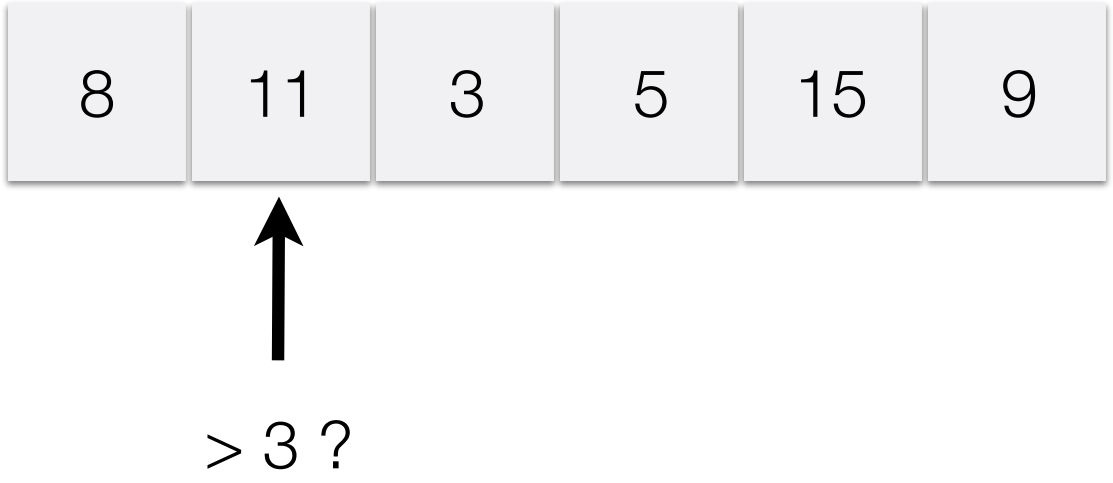


Insertion Sort

Current 3

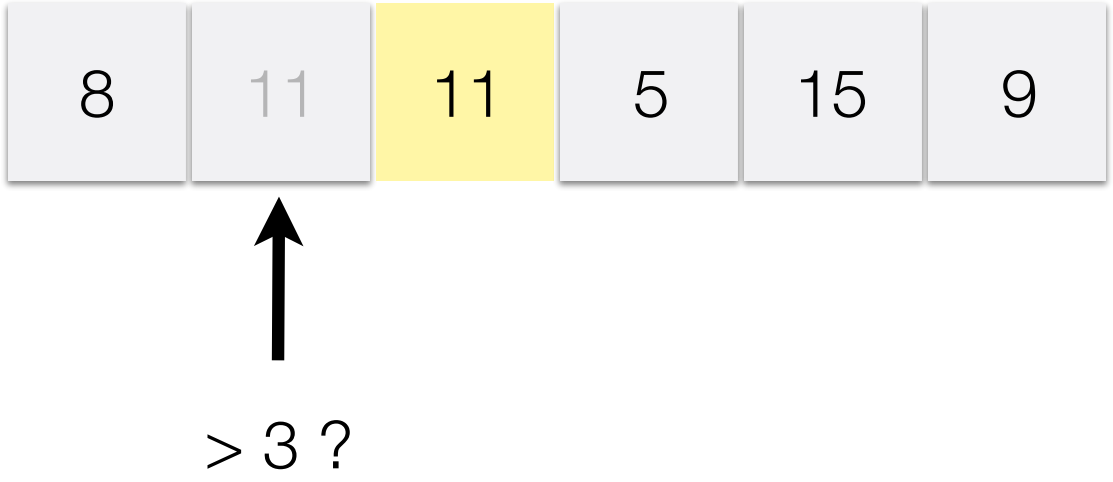
Insertion Sort

Current 3



Insertion Sort

Current 3

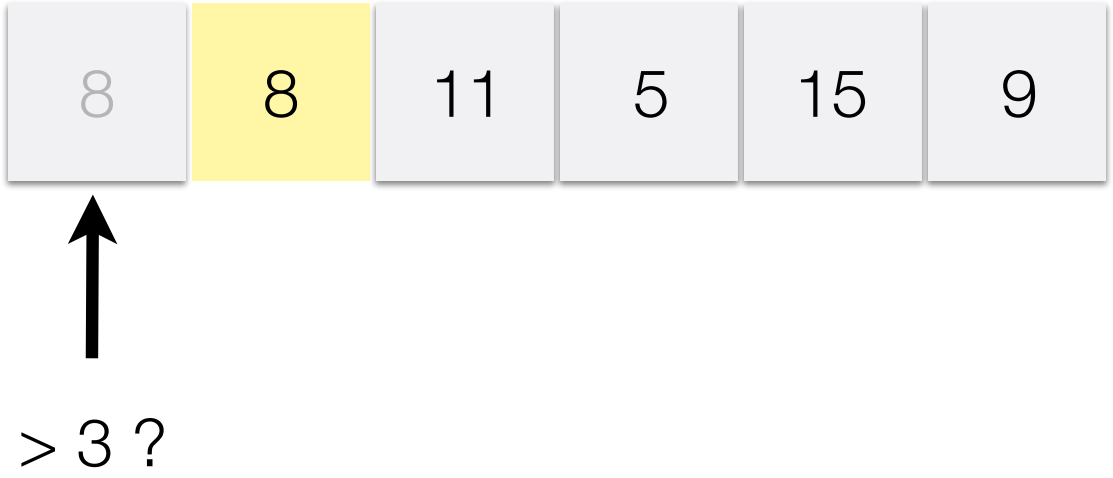


Insertion Sort

Current 3

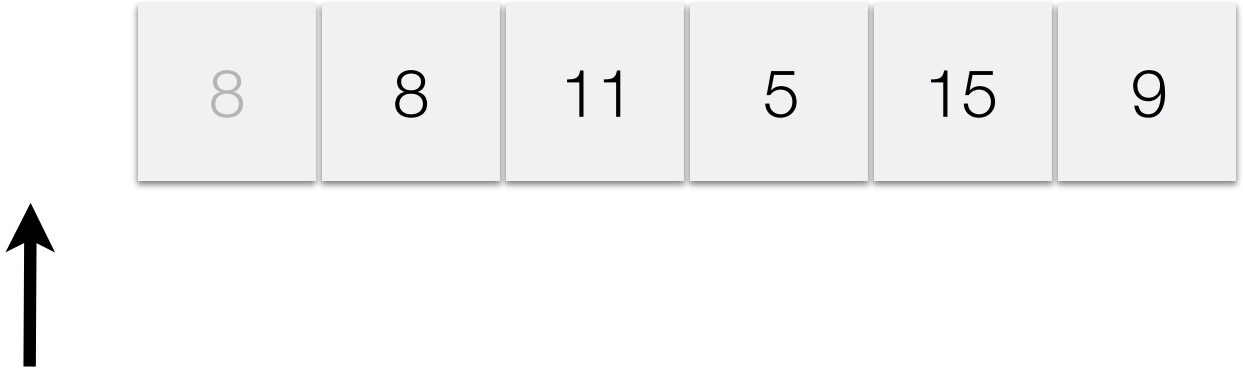
Insertion Sort

Current 3



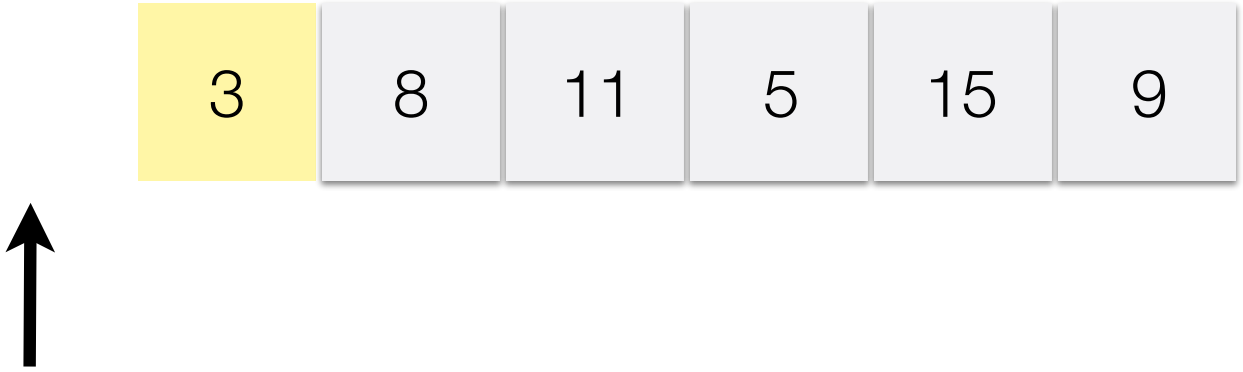
Insertion Sort

Current 3

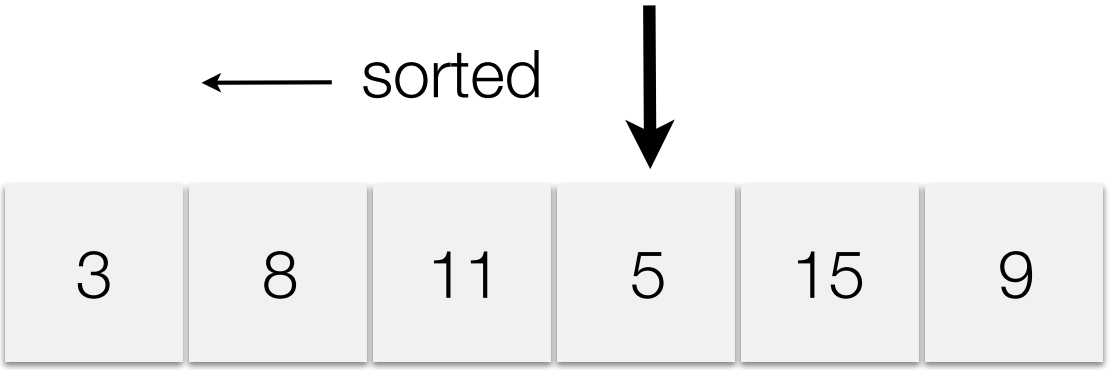


Insertion Sort

Current 3

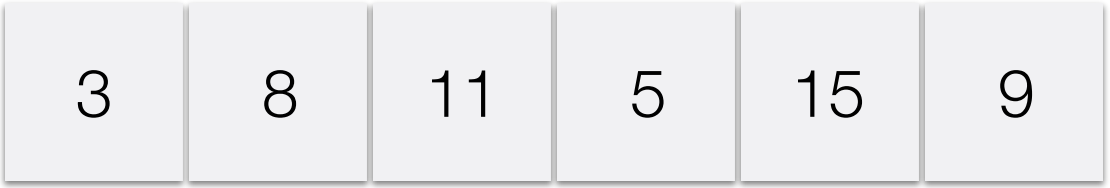


Insertion Sort



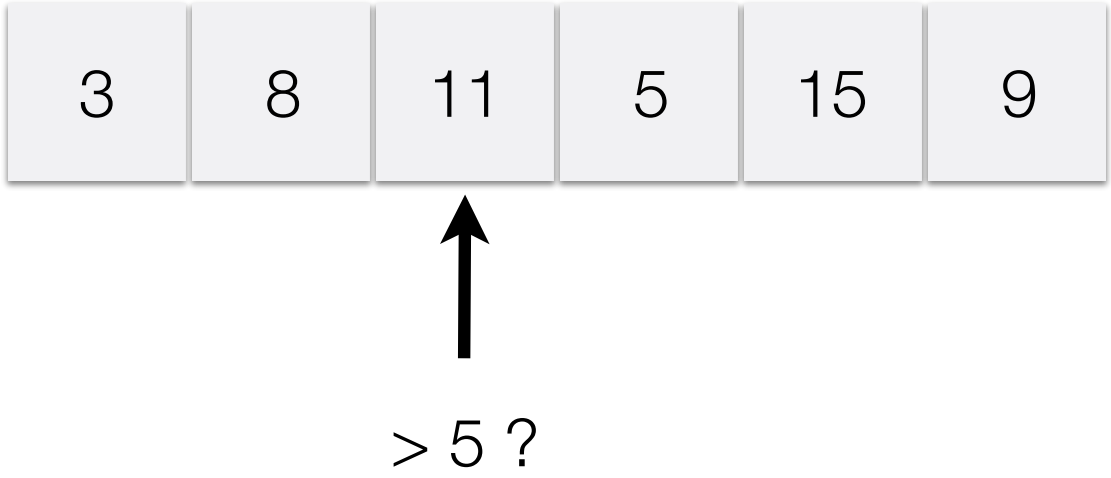
Insertion Sort

Current 5



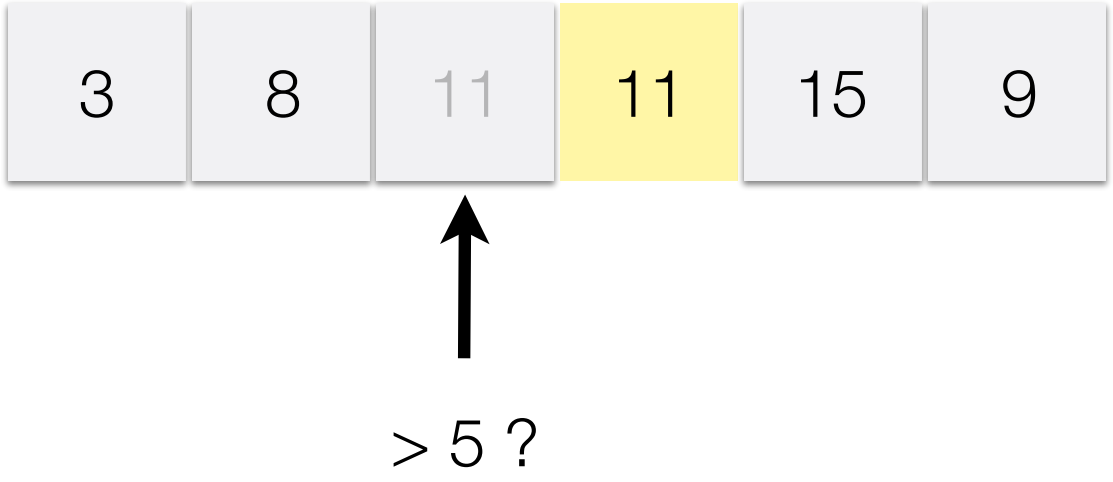
Insertion Sort

Current 5



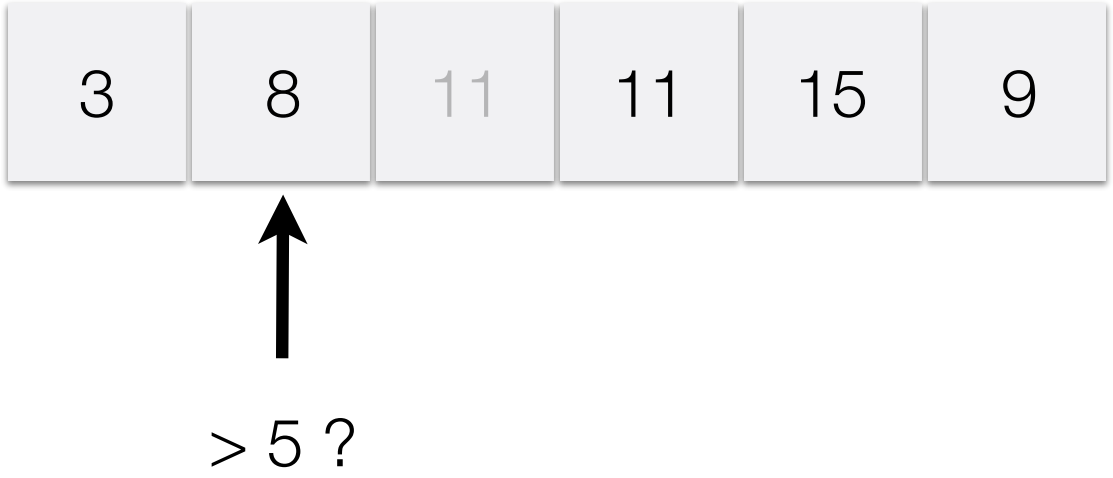
Insertion Sort

Current 5



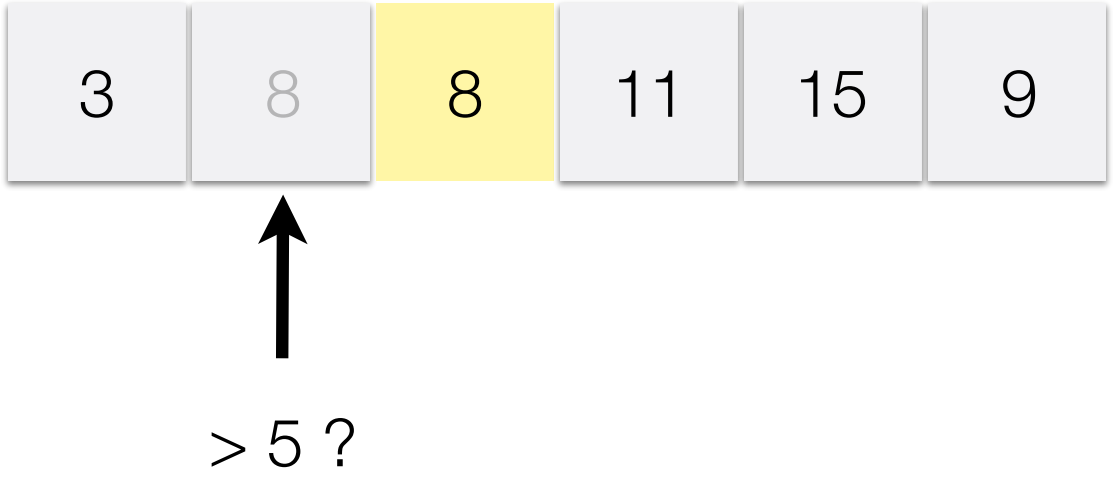
Insertion Sort

Current 5



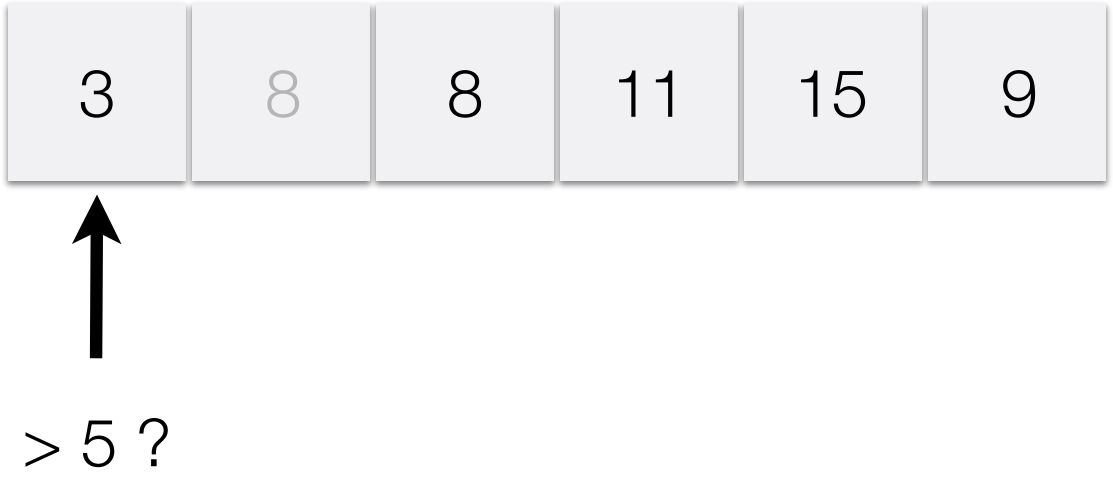
Insertion Sort

Current 5



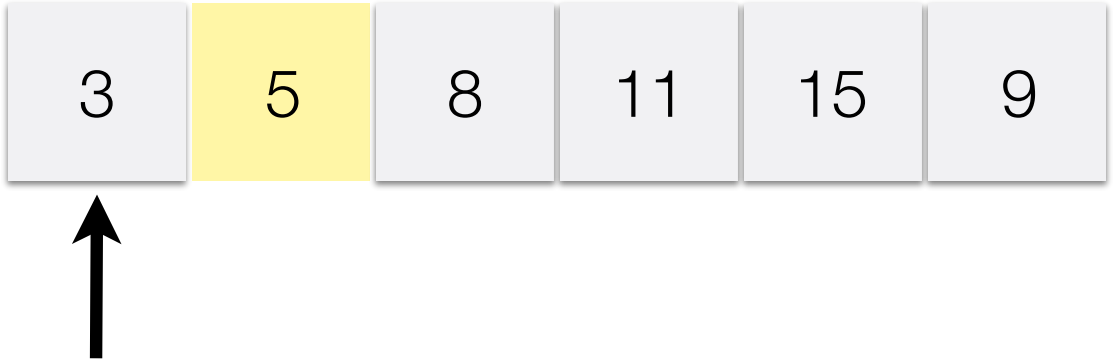
Insertion Sort

Current 5

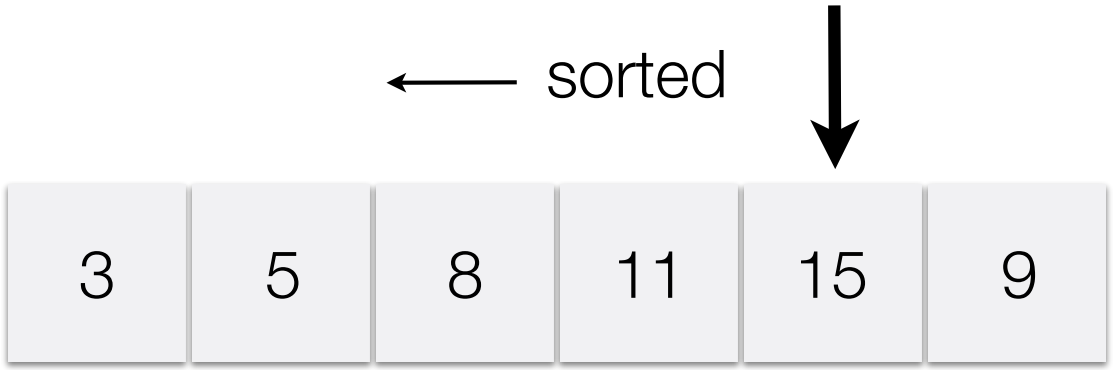


Insertion Sort

Current 5



Insertion Sort

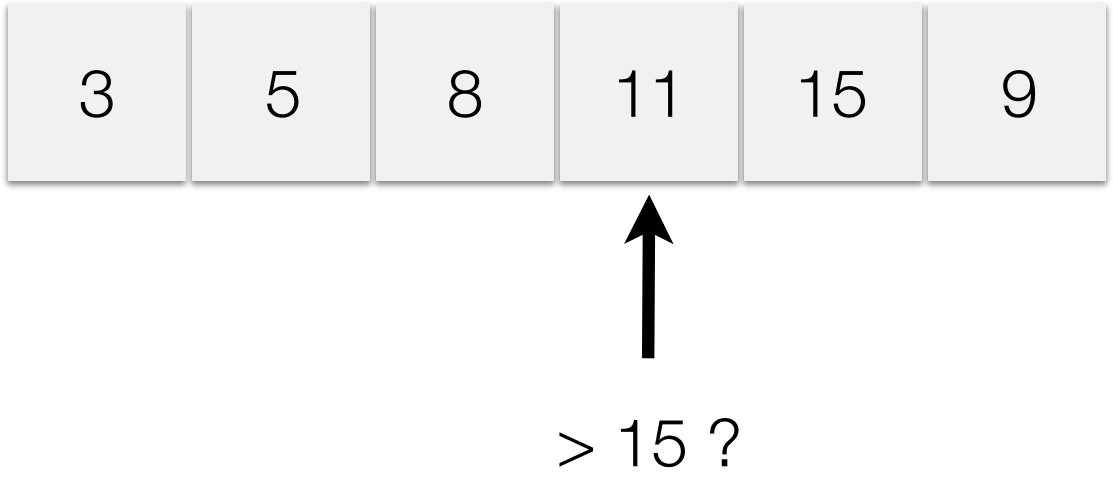


Insertion Sort

Current 15

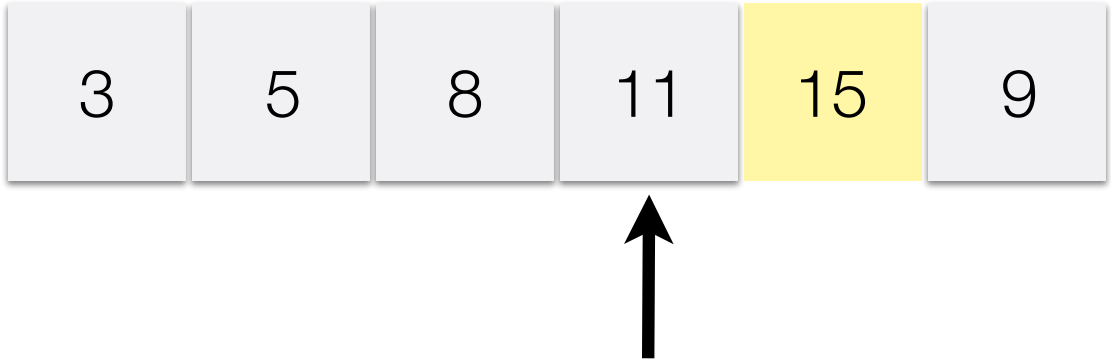
Insertion Sort

Current 15

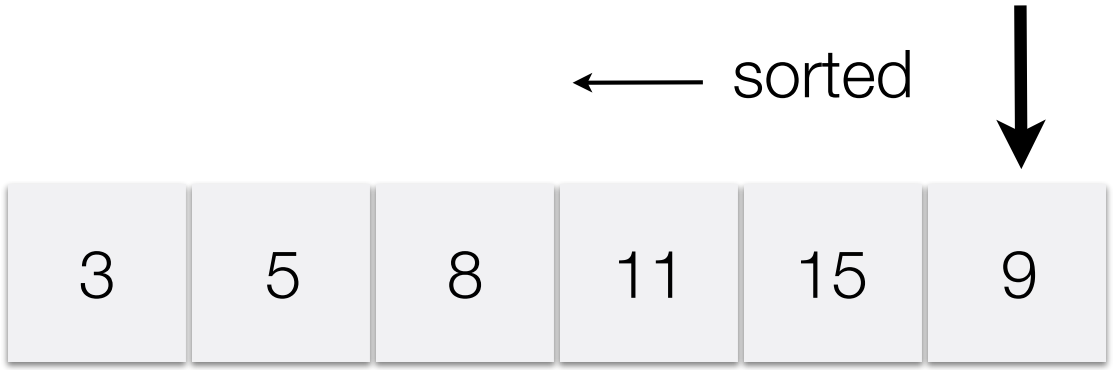


Insertion Sort

Current 15



Insertion Sort

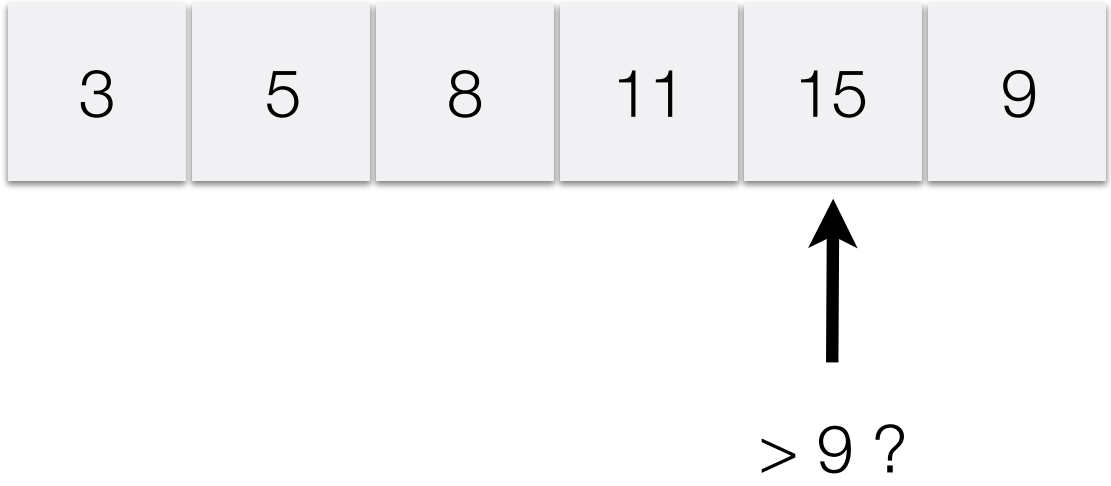


Insertion Sort

Current 9

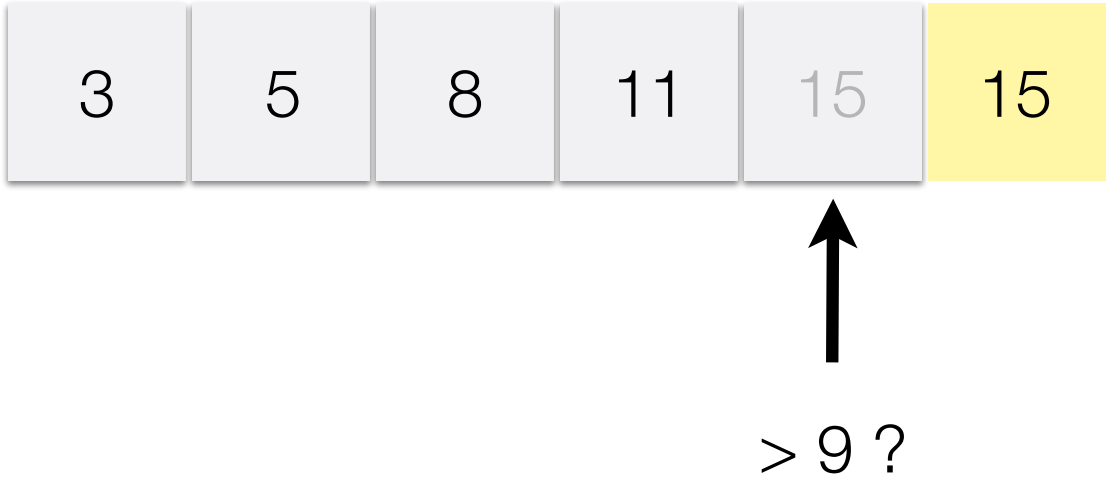
Insertion Sort

Current 9



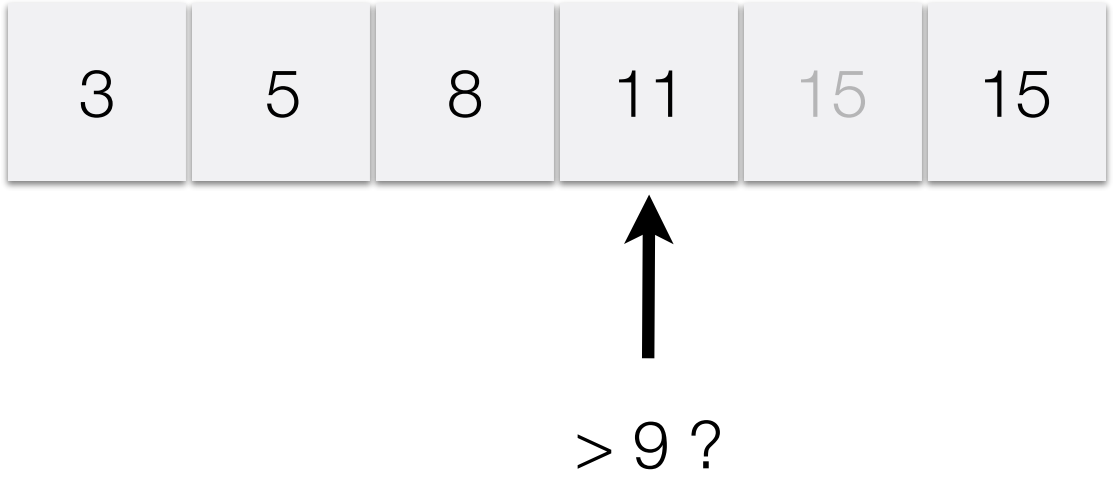
Insertion Sort

Current 9



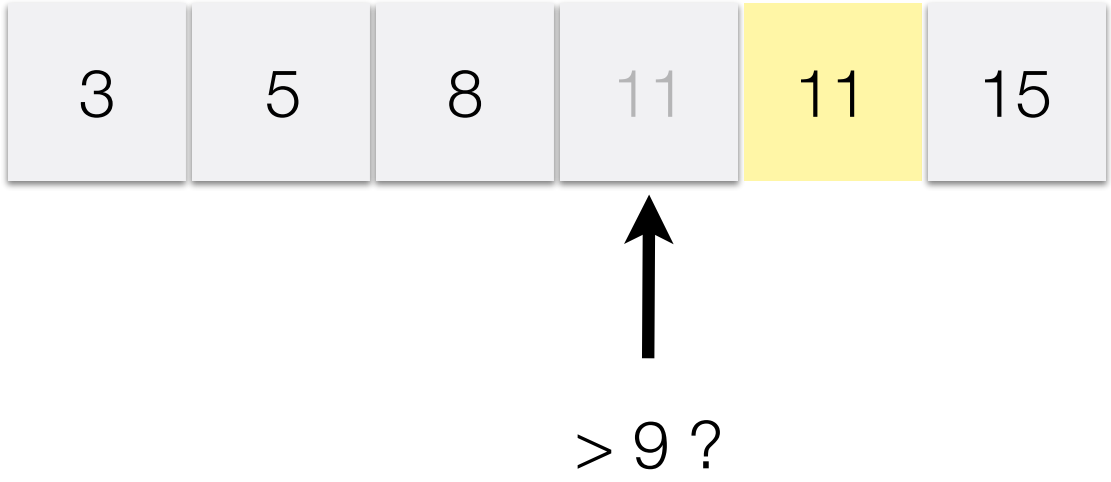
Insertion Sort

Current 9



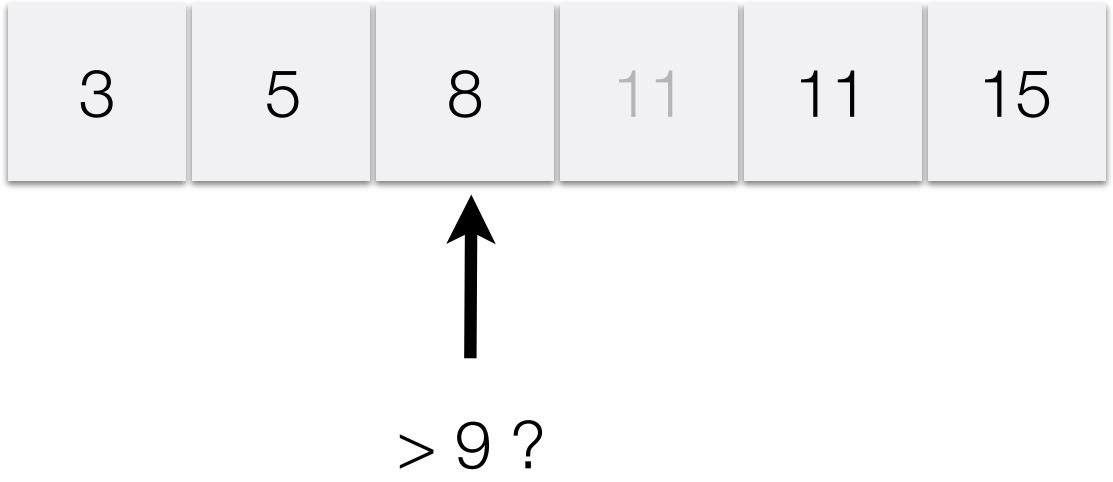
Insertion Sort

Current 9



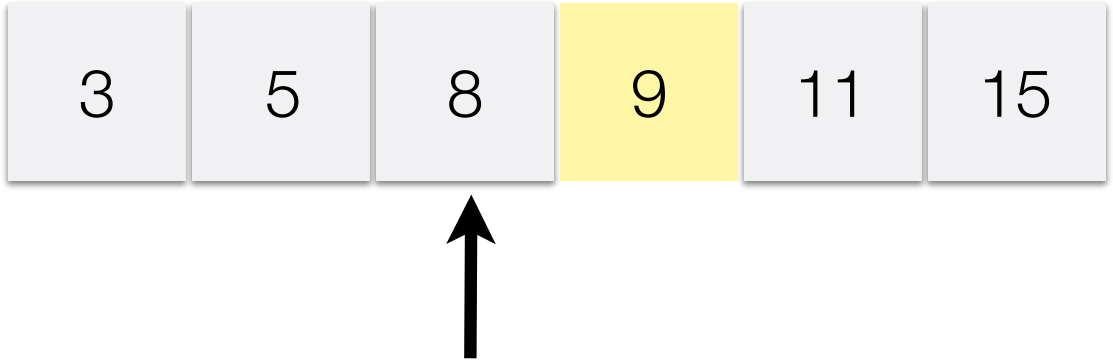
Insertion Sort

Current 9



Insertion Sort

Current 9



Insertion Sort

Insertion Sort

```
public static void insertionSort(List<Integer> list) {

  for (int i = 1; i < list.size(); i++) {
    // Get current element
    int cur = list.get(i);
    int j;
    // Starting from left neighbour, shift all elements
    // greater than cur to the right
    for (j = i - 1; j >= 0 && cur < list.get(j); j--) {
      list.set(j + 1, list.get(j));
    }
    // Now, j points to the first element smaller or
    // equal to cur, so put cur in slot j+1
    list.set(j + 1, cur);
  }
}
```

Insertion Sort: Analysis

- For a list of length *n*, main for loop has *n* steps
- In the worst case, the inner loop shifts all elements left of the current one place to the right

$$1 + 2 + 3 + \ldots + (n-1) + n = \frac{n \cdot (n+1)}{2}$$

  which grows proportionally to n^2 for large *n*

- Insertion Sort is in $O(n^2)$, or *quadratic*

For very small (or mostly already sorted) inputs, insertion sort is the fastest algorithm